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I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231. Katrina T. Holland, Lillian S. Glenn, Amy J. Martin, Karen S. Flynn, Paige E. Snyder, Shaylor E. Dunn, BONNIE S. SHERIDAN
Bonnie S. Sheridan

Rec'd PCT/PTO 18 DEC 2001

TORNEY'S DOCKET NUMBER 06/34

APPLICATION NO (If known, see 37 CFR 1.5) 10/018976

INTERNATIONAL APPI
PCT/DE00/02065

IORITY DATE CLAIMED
June 1999 (25.06.99)

TITLE OF INVENTION
CODEC CIRCUIT HA[illegible] A PROGRAMMABLE DIGITAL BANDPASS FILTER

APPLICANT(S) FOR DO/EO/US INFINEON TECHNOLOGIES, AG and KOGLER, Manfred

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [X] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [X] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [X] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [X] An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [ ] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. [X] Other items or information:

Copy of PCT/IPEA/416; copy of PCT/IPEA/409; copy of WO 01/01570

S APPLICATION NO (if known, see 37 CFR 1.5) 10/018976	INTERNATIONAL APPLICATION NO PCT/DE00/02065	531 Rec'd PCT/PT 18 DEC 2001 ATTORNEY'S DOCKET NUMBER 1406/34

21. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**

CALCULATIONS PTO USE ONLY		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$	890.00
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	9 - 20 =	0	x **$18.00**	$	0.00
Independent claims	1 - 3 =	0	x **$84.00**	$	0.00
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$280.00**	$	0.00
TOTAL OF ABOVE CALCULATIONS =				$	890.00
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.			+	$	0.00
SUBTOTAL =				$	890.00
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TOTAL NATIONAL FEE =				$	890.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	0.00
TOTAL FEES ENCLOSED =				$	890.00
			Amount to be refunded:	$	
			charged:	$	

a. [X] A check in the amount of $ 890.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-0426. A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

Richard E. Jenkins
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25297
PATENT TRADEMARK OFFICE

Richard E Jenkins
SIGNATURE

Richard E. Jenkins
NAME

28,428

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Manfred Kogler

Group Art Unit: Not Assigned

Serial No.: Not Assigned

Examiner: Not Assigned

Filed: Herewith

Docket No.: 1406/34

For: CODEC CIRCUIT HAVING A PROGRAMMABLE DIGITAL BANDPASS FILTER

* *

PRELIMINARY AMENDMENT

Honorable Commissioner for Patents
BOX PCT
Washington, D.C. 20231

Dear Sir:

Kindly amend the subject application as follows:

IN THE SPECIFICATION:

Please insert the paragraph heading on page 1 of the English translation of the Annex to Form PCT/IPEA/409, line 5, as follows:

--Technical Field --.

Please insert the paragraph heading on page 1 of the English translation of the Annex to Form PCT/IPEA/409, line 10, as follows:

--Background Art --.

Please insert the paragraph heading on page 2 of the English translation of the Annex to Form PCT/IPEA/409, line 5, as follows:

--Summary of the Invention--.

Please insert the paragraph heading on page 4 of the English translation of the Annex to Form PCT/IPEA/409, before line 14, as follows:

--Brief Description of the Drawings--.

Please insert the paragraph heading on page 5 of the English translation of the Annex to Form PCT/IPEA/409, before line 1, as follows:

--Detailed Description of the Invention--.

IN THE CLAIMS:

Please delete the paragraph heading on page 14 of the English translation of the Annex to Form PCT/IPEA/409, line 1, and insert in place thereof the paragraph heading as follows:

--CLAIMS--

Please insert the paragraph heading on page 14 of the English translation of the Annex to Form PCT/IPEA/409, before claim 1, the following:

-- What is claimed is: --.

Please amend claims 1-9 as follows:

1. (Amended) A codec circuit having a programmable digital bandpass filter, for matching the filter characteristics of the codec circuit to a transmitted PCM signal, having at least one programmable digital high-pass filter and at least one programmable digital low-pass filter connected in series with it, in which case the setting filter coefficients for the programmable digital high-pass and low-pass filters can each be set, by means of a signal identification device for identification of a PCM signal transmitted through the codec circuit, as a function of the transmitted PCM signal in order to vary a bandpass filter characteristic for the programmable digital bandpass filter.

2. (Amended) The codec circuit as claimed in claim 1, wherein the setting filter coefficients can be stored in coefficient memory devices which are associated with the programmable digital high-pass and low-pass filters.

3. (Amended) The codec circuit as claimed in claim 2, wherein the memory devices are random access memories (RAM).

4. (Amended) The codec circuit as claimed in claim 2, wherein the memory devices are connected via coefficient setting lines to the signal identification device.

5. (Amended) The codec circuit as claimed in claim 1, wherein the programmable digital filters are each seventh-order filters.

6. (Amended) The codec circuit as claimed in claim 1, wherein the upper and lower signal transmission cut-off frequencies of the bandpass filter and the gradient of the bandpass filter flanks can be set by means of the setting filter coefficients.

7. (Amended) The codec circuit as claimed in claim 6, wherein the lower signal transmission cut-off frequency can be set by setting the setting filter coefficients of the digital high-pass filter.

8. (Amended) The codec circuit as claimed in claim 6, wherein the upper signal transmission cut-off frequency can be set by setting the setting filter coefficients of the programmable digital low-pass filter.

9. (Amended) The codec circuit as claimed in claim 1, wherein a frequency response correction filter is also provided, in order to compensate for the ripple in the bandpass filter characteristic in the passband.

REMARKS

The amendments to the specification as set forth above are intended to clarify and set apart the various sections of the subject application.

The amendments to the claims as set forth above are intended to remove all multiple dependent claims from the subject application and to more particularly point out and distinctly claim the subject invention.

Attached hereto is a marked-up version of the specification and claims 1-9, which illustrates all of the changes made to the specification and claims pursuant to 37 CFR §1.121. The attached page is captioned "**Version With Markings To Show Changes Made**". Deleted language is bracketed and added language is underlined.

The Commissioner is hereby authorized to charge any deficiencies or credit any overpayments in connection with the filing of this correspondence to Deposit Account No. **50-0426**.

Respectfully submitted,

JENKINS & WILSON, P.A.

Date: 12-18-01 By: Richard E. Jenkins

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25297
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1406/34 REJ/lsg

Serial No.: Not yet assigned

Version With Markings To Show Changes Made

IN THE SPECIFICATION:

The paragraph heading has been inserted on page 1 of the English translation of the Annex to Form PCT/IPEA/409, line 5, as follows:

Technical Field

The paragraph heading has been inserted on page 1 of the English translation of the Annex to Form PCT/IPEA/409, line 10, as follows:

Background Art

The paragraph heading has been inserted on page 2 of the English translation of the Annex to Form PCT/IPEA/409, line 5, as follows:

Summary of the Invention

The paragraph heading has been inserted on page 4 of the English translation of the Annex to Form PCT/IPEA/409, before line 14, as follows:

Brief Description of the Drawings

The paragraph heading has been inserted on page 5 of the English translation of the Annex to Form PCT/IPEA/409, before line 1, as follows:

Detailed Description of the Invention

IN THE CLAIMS:

The paragraph heading "Patent Claims" on page 14 of the English translation of the Annex to Form PCT/IPEA/409 has been deleted and the paragraph heading has been inserted in place thereof as follows:

CLAIMS

The paragraph heading has been inserted on page 14 of the English translation of the Annex to Form PCT/IPEA/409, before claim 1, as follows:

What is claimed is:

1. (Amended) A codec circuit having a programmable digital bandpass filter [(6)], for matching the filter characteristics of the codec circuit to a transmitted PCM signal, having at least one programmable digital high-pass filter [(29)] and at least one programmable digital low-pass filter [(31)] connected in series with it, in which case the setting filter coefficients for the programmable digital high-pass and low-pass filters [(29, 31)] can each be set, by means of a signal identification device [(24)] for identification of a PCM signal transmitted through the codec circuit, as a function of the transmitted PCM signal in order to vary a bandpass filter characteristic for the programmable digital bandpass filter [(6)].

2. (Amended) The codec circuit as claimed in claim 1, wherein the setting filter coefficients can be stored in coefficient memory devices [(32, 33)] which are associated with the programmable digital high-pass and low-pass filters [(29, 31)].

3. (Amended) The codec circuit as claimed in claim [1 or] 2, wherein the memory devices [(32, 33)] are random access memories (RAM).

4. (Amended) The codec circuit as claimed in [one of the preceding claims 1 to 3] claim 2, wherein the memory devices [(32, 33)] are connected via coefficient setting lines [(22, 23)] to the signal identification device [(24)].

5. (Amended) The codec circuit as claimed in [one of the preceding claims 1 to 4] claim 1, wherein the programmable digital filters [(29, 31)] are each seventh-order filters.

6. (Amended) The codec circuit as claimed in [one of the preceding claims 1 to 5] claim 1, wherein the upper and lower signal transmission cut-off frequencies of the bandpass filter [(6)] and the gradient of the bandpass filter flanks can be set by means of the setting filter coefficients.

7. (Amended) The codec circuit as claimed in claim 6, wherein the lower signal transmission cut-off frequency can be set by setting the setting filter coefficients of the digital high-pass filter [(29)].

8. (Amended) The codec circuit as claimed in claim 6, wherein the upper signal transmission cut-off frequency can be set by setting the setting filter coefficients of the programmable digital low-pass filter [(29)].

9. (Amended) The codec circuit as claimed in [one of the preceding claims 1 to 8] claim 1, wherein a frequency response correction filter [(10, 13)] is also provided, in order to compensate for the ripple in the bandpass filter characteristic in the passband.

Description

Codec circuit having a programmable digital bandpass filter

The present invention relates to a codec circuit having a programmable digital bandpass filter for matching the filter characteristics of the codec circuit to a transmitted PCM signal.

US-A-5,212,817 discloses a programmable digital bandpass filter for a codec circuit for adaptation of the filter characteristics, in which case the setting filter coefficients can be set by changing the bandpass filter characteristic of the programmable digital bandpass filter.

A codec circuit is a circuit which intrinsically combines the functions of a coding switching device and a decoding switching device. When transmitting information, information is in many cases transmitted in both directions between two connections. In this situation, the codec circuit would carry out PCM (Pulse Code Modulation) signal coding in the transmission direction and PCM signal decoding in the reception direction.

In practice, codec circuits are normally in the form of digital signal processors (DSP), which are highly specialized, but nevertheless standardized, integrated circuits produced in large quantities for high-speed processing of a narrowly constrained set of input signals in real time. Digital signal processors such as these are typically used for data transmission by means of modems. A modem is a terminal which modulates outgoing signals and demodulates received signals.

For signal transmission of voice signals, the filter characteristics of the codec circuit have to comply with specific, predetermined specifications. There are no such specifications for the filter characteristics for signal transmission of modem signals.

Since the transmission rate of modems is directly proportional to the transmission frequency bandwidth, the data transmission rate increases with increasing frequency bandwidth of the digital filters integrated in the codec circuit. The digital filters which have been used in known codec circuits until now have filter characteristics matched to the specifications which exist for transmission of voice signals, and are not programmable. It is thus impossible when using such digital filters for codec circuits according to the prior art to widen the filter bandwidth, or to reset

it, for data transmission when modem signals are being transmitted from a first modem to a second modem instead of the normal voice signals which originate, for example, from a telephone.

The object of the present invention is thus to provide a codec circuit, in which the data transmission frequency range can be matched to the transmitted PCM signal.

According to the invention, this object is achieved by a programmable digital bandpass filter having the features specified in patent claim 1.

Further advantageous refinements are specified in the dependent claims. The invention is in this case based on the idea of providing the programmable digital bandpass filter in addition to the digital filters with fixed settings in the codec circuit, in order that the filter bandwidth, and hence the data transmission rate, can be matched to the transmitted PCM signal.

In one advantageous refinement of the codec circuit according to the invention, the setting filter coefficients can be stored in coefficient memory devices, which are associated with the digital high-pass filter and the digital low-pass filter.

This offers the particular advantage that the coefficients of the digital filters can be matched to or reprogrammed for technical requirements of the transmission channel and to and for the transmitted PCM signal at any time.

In a further advantageous refinement, the memory devices are random access memories (RAMs).

The memory devices are preferably connected via coefficient setting lines to a signal identification device for identification of the PCM signal transmitted through the codec circuit.

This offers the particular advantage that the setting of the setting filter coefficients, and hence the matching of the filter characteristics of the codec circuit to the transmitted PCM signal, can be carried out automatically by identifying the nature of the transmitted PCM signal, without any need for manual programming for each specific case. The programmable digital filters are preferably seventh-order filters.

In one preferred embodiment, the upper and the lower signal transmission cut-off frequencies for the digital bandpass filter and the gradient of the bandpass filter flanks can be set separately by means of the setting filter coefficients.

This offers the particular advantage that the two signal transmission cut-off frequencies of the bandpass filter can be set independently of one another. Furthermore, the gradient of the bandpass filter flanks can be programmed in accordance with the requirements for the transmission channel.

The lower signal transmission cut-off frequency of the bandpass filter can preferably be set by setting the setting filter coefficients of the digital high-pass filter.

The upper signal transmission cut-off frequency of the bandpass filter can preferably be set by setting the setting filter coefficients of the digital low-pass filter. In one preferred embodiment, a frequency response correction filter is also connected in series

with the digital low-pass filter and the digital high-pass filter in order to compensate for the ripple in the frequency passband of the bandpass filter.

This offers the particular advantage that the transmitted PCM signal is filtered uniformly, independently of the frequency, throughout the frequency passband of the bandpass filter. One preferred embodiment of a codec circuit is described in the following text, in order to explain the features that are essential to the invention, with reference to the attached drawings, in which:

Figure 1 shows a codec circuit, in which programmable digital bandpass filters according to the invention are used both in the transmission signal path and in the reception signal path of the codec circuit;

Figure 2 shows a block diagram of the codec circuit according to the invention;

Figure 3 shows a typical filter characteristic of a codec circuit as a function of the filters that are used in the transmission signal path of the codec circuit;

Figure 4 shows a filter transmission characteristic of a codec circuit in the region of the lower cut-off frequency for various filter coefficient settings;

Figure 5 shows a filter transmission characteristic of a codec circuit in the region of the upper cut-off frequency.

Figure 1 shows a block diagram of a codec circuit, in which a transmission signal is PCM-coded and a received PCM signal is decoded. The codec circuit has a transmission signal path and a reception signal path for this purpose.

The analog input filter is preferably an analog high-pass filter for outputting alternating signals. On the output side, the analog input filter 2 is connected via a line 3 to an analog/digital converter 4. The analog/digital converter 4 samples the filtered analog signal supplied to it via the line 3, and produces a digital output signal, which is passed via the line 5 to the programmable digital bandpass filter 6 according to the invention. The digital bandpass filter 6 has a bandpass filter characteristic and filters the digital signal applied on the line 5 such that only signals in the frequency passband of the bandpass filter are passed via a line 7 to a digital high-pass filter 8. The digital high-pass filter has a high-pass filter characteristic which is permanently set and cannot be varied.

for this purpose.

A transmission signal originating from a telephone or a transmission modem is applied via an input line 1 to an analog input filter 2. The analog input filter is preferably an analog high-pass filter for outputting alternating signals. On the output side, the analog input filter 2 is connected via a line 3 to an analog/digital converter 4. The analog/digital converter 4 samples the filtered analog signal supplied to it via the line 3, and produces a digital output signal, which is passed via the line 5 to the programmable digital bandpass filter 6 according to the invention. The digital bandpass filter 6 has a bandpass filter characteristic and filters the digital signal applied on the line 5 such that only signals in the frequency passband of the bandpass filter are passed via a line 7 to a digital high-pass filter 8. The digital high-pass filter has a high-pass filter characteristic which is permanently set and cannot be varied.

On the output side, the digital high-pass filter 8 is connected via a line 9 to a frequency response correction filter 10. The frequency response correction filter 10 compensates for ripple in the passband of the bandpass filter characteristic.

The transmission signal path in the codec circuit is formed, as is shown in Figure 1, by the analog input filter 2, the analog/digital converter 4, the programmable digital bandpass filter 6, the digital high-pass filter 8, whose setting is fixed, and by the frequency response correction filter 10. In this case, the analog input filter 2 and the digital high-pass filter 8, whose setting is fixed, can be connected via control lines 11, 12 to the transmission signal path of the codec circuit. If the input filter 2 is switched

off via the control line 11, the signal which is applied on the input line 1 is passed directly, without being filtered, to the input of the analog/digital converter 4. If the digital high-pass filter 8 is switched off via the control line 12, the output signal from the programmable digital bandpass filter 6 is passed directly to the frequency response correction filter 10.

The reception signal path of the codec circuit illustrated in Figure 1 likewise has a frequency response correction filter 13, whose input side is connected to a receiving line 14. The design of the frequency response correction filter 13 is similar to that of the frequency response correction filter 10. According to the invention, a line 15 connects a programmable digital bandpass filter 6 which is connected in the reception signal path of the codec circuit, to the frequency response connection filter 13. The output signal, having been filtered by the programmable digital bandpass filter 6, is supplied via a line 16 to a digital/analog converter 17, which converts the received digital signal to an analog signal, and preferably emits this signal via a line 18 to an analog output filter 19. In one preferred embodiment, the analog output filter 19 can be connected to the reception signal path of the codec circuit, via a control line 20. The output signal from the output filter 19 is emitted via an output

line 21 to, for example, an SLIC circuit, which is not illustrated.

The two programmable digital bandpass filters in the codec circuit for matching the filter characteristics of the codec circuit to the PCM signal transmitted in the transmission signal path or the reception signal path can be controlled by a signal identification

device 24, via control lines 22, 23, in the preferred embodiment illustrated in Figure 1.

The signal identification device 24 identifies the PCM signal transmitted through the codec circuit. The signal identification device 24 is connected via detection lines (which are not illustrated) to the transmission signal path and/or to the reception signal path of the codec circuit. An evaluation circuit, which is integrated in the signal identification device 24, is used to evaluate and to identify the PCM signal in the transmission signal path or the reception signal path. The evaluation circuit identifies the type of modulation and the transmission speed such that, firstly, it is possible to determine whether the transmitted PCM signal originates from a terminal, for example a modem, or from a telephone for voice transmission. Furthermore, the evaluation circuit identifies the type of transmitting or receiving modem. For example, the evaluation circuit identifies whether the transmitting modem is a V.90 modem or a V.34 modem. The signal identification device 24 sets the optimum digital filter coefficients for the digital bandpass filters, via the control lines 22, 23, to match the identified modem. In this case, the filter coefficients are preferably set automatically.

Figure 2 shows the programmable digital bandpass filter, as illustrated in Figure 1, according to the invention, in detail.

The programmable digital bandpass filter 6 has an input connection 25, an output connection 26 and a control or setting connection 27. The control connection 27 is connected via a control line 22 or 23 to the signal identification device 24 shown in Figure 1. The input connection 25 is connected via an internal input line 28 to a programmable digital high-pass filter 29. The

programmable digital high-pass filter 29 is connected in series with a programmable digital low-pass filter 34 via a line 30. The setting filter coefficients of the programmable digital high-pass filter 29 can be stored in an associated memory device 32. The setting filter coefficients of the programmable digital low-pass filter 31 can be stored in an associated memory device 33. The memory devices 32, 33 are preferably random access memories (RAMs). The setting filter coefficients stored there can be reprogrammed by the signal identification device 24. To do this, the memory devices 32, 33 are connected to the control connection 27 via internal memory setting lines 34, 35, 36.

The programmable digital low-pass filter 31 is connected on the output side via an internal output line 37 to the output connection 26 of the programmable digital bandpass filter 6.

In the embodiment shown in Figure 2, the programmable digital low-pass filter 31 is connected downstream from the programmable digital high-pass filter 29. In an alternative embodiment, the programmable digital high-pass filter 29 is connected downstream from the programmable digital low-pass filter 31.

In further embodiments of the programmable digital bandpass filter according to the invention, a large number of programmable digital high-pass filters 29 and a large number of programmable digital low-pass filters 31 can be connected in series. The programmable digital low-pass filters 31 may in this case at the same time be in the form of interpolation and decimation filters.

In one preferred embodiment of the programmable digital bandpass filter 6 according to the invention, the

programmable digital filters 29, 31 are seventh-order filters.

The setting filter coefficients which can be stored in the memory devices 32, 33 set the filter characteristics of the digital filters 29, 31 via lines 38, 39.

A bandpass filter characteristic is achieved by connecting the programmable digital high-pass filter 29 and a programmable digital low-pass filter 31 in series. The setting coefficients in this case make it possible to set the upper and the lower signal transmission cut-off frequencies of the digital bandpass filter 6 according to the invention and the gradient of the bandpass filter flanks independently of one another. However, the programmable digital bandpass filter according to the invention can be set in a flexible manner to satisfy the individual requirements of the transmission channel and the type of modem being used.

In this case, the lower cut-off frequency of the bandpass filter characteristic can be set by setting the setting filter coefficients of the digital high-pass filter 29, and the upper signal transmission cut-off frequency of the bandpass filter characteristic can be set by setting the setting filter coefficients of the digital low-pass filter 31.

In one preferred embodiment, the frequency response correction filters 10, 13, as are shown in Figure 1, are integrated in the programmable digital bandpass filter 6, with the compensation for the ripple in the bandpass filter characteristic being carried out automatically as a function of the filter coefficient settings.

Figure 3 shows the frequency response characteristic of the codec circuit shown in Figure 1, in the region of the lower cut-off frequency. As can be seen from Figure 3, the lower cut-off frequency occurs at about 100 to 200 Hz.

The filter transmission curve a shows a filter characteristic of the codec circuit when only the input filter 2 is switched on, corresponding to the switch-on control signal supplied via the control line 11. The filter transmission curve b shows the situation when the digital high-pass filter 8, whose setting is fixed, is also connected in the transmission signal path of the codec circuit, by means of a control signal on the control line 12. Finally, the filter transmission curve c shows the situation in which the programmable digital high-pass filter 29 in the programmable digital bandpass filter 6 according to the invention is also connected in the transmission signal path of the codec circuit. The digital programmable bandpass filter 6 is preferably connected in the signal transmission path automatically by the signal identification device 24 on identifying a corresponding PCM signal via a separate control line.

As can be seen from Figure 3, the lower cut-off frequency of the codec circuit is increased by the addition of the digital bandpass filter 6 according to the invention, and occurs at about 200 Hz. The lower cut-off frequency of the codec circuit can thus be set individually as a function of the transmitted PCM signal. In the example shown in Figure 3, the cut-off frequency is set in the range from 50 Hz to 200 Hz.

Figure 4 shows the filter transmission characteristic of the codec circuit shown in Figure 1 when the various high-pass filters are added, that is to say the analog input filter 2, the digital programmable high-pass

filter 29 within the digital programmable bandpass filter, and the fixed digital high-pass filter 8. In this case, in contrast to Figure 3, Figure 4 also shows the filter characteristic being changed as a function of the filter coefficient. As can be seen from Figure 4, not only is the lower signal transmission cut-off frequency of the codec circuit but also the gradient of the lower bandpass filter flank, as well. This allows fine adjustment of the codec circuit.

Figure 5 shows the filter transmission characteristic of the digital programmable low-pass filter 31 within the programmable digital bandpass filter 6. As can be seen from Figure 5, switching the digital programmable low-pass filter 31 to different filter coefficients reduces the upper cut-off frequency.

As can be seen from Figures 3 to 5, the addition of the programmable digital bandpass filter 6 reduces the frequency passband, since the lower cut-off frequency is increased and the upper cut-off frequency is decreased. Conversely, the frequency passband is widened, and the data transmission rate thus increased, by changing the coefficients of the programmable digital bandpass filter 6.

The filter transmission characteristic can be programmed differently in the transmission signal path and in the reception signal path of the codec circuit. For example, if a V.90 modem is used, the transmission direction can be matched to V.34 modem transmission by means of a higher upper cut-off frequency in the digital programmable high-pass filter 29 in the programmable digital bandpass filter 6 connected in the reception signal path, while the full frequency bandwidth is available in the reception direction. Use of the programmable digital bandpass filter 6 according to the invention within the codec circuit makes it

possible to utilize the frequency range as far as possible, particularly for terminals and modems. The programmable digital bandpass filter 6 according to the invention furthermore offers the capability to program the cut-off frequencies independently of one another.

It is thus possible firstly to satisfy the predetermined specifications for voice transmission, and secondly to achieve optimum utilization of the frequency range for modem signal transmissions.

Patent Claims

1. A codec circuit having a programmable digital bandpass filter (6), for matching the filter characteristics of the codec circuit to a transmitted PCM signal, having at least one programmable digital high-pass filter (29) and at least one programmable digital low-pass filter (31) connected in series with it, in which case the setting filter coefficients for the programmable digital high-pass and low-pass filters (29, 31) can each be set, by means of a signal identification device (24) for identification of a PCM signal transmitted through the codec circuit, as a function of the transmitted PCM signal in order to vary a bandpass filter characteristic for the programmable digital bandpass filter (6).

2. The codec circuit as claimed in claim 1, wherein the setting filter coefficients can be stored in coefficient memory devices (32, 33) which are associated with the programmable digital high-pass and low-pass filters (29, 31).

3. The codec circuit as claimed in claim 1 or 2, wherein the memory devices (32, 33) are random access memories (RAM).

4. The codec circuit as claimed in one of the preceding claims 1 to 3,
wherein
the memory devices (32, 33) are connected via coefficient setting lines (22, 23) to the signal identification device (24).

5. The codec circuit as claimed in one of the preceding claims 1 to 4, wherein the programmable digital filters (29, 31) are each seventh-order filters.

6. The codec circuit as claimed in one of the preceding claims 1 to 5, wherein the upper and lower signal transmission cut-off frequencies of the bandpass filter (6) and the gradient of the bandpass filter flanks can be set by means of the setting filter coefficients.

7. The codec circuit as claimed in claim 6, wherein the lower signal transmission cut-off frequency can be set by setting the setting filter coefficients of the digital high-pass filter (29).

8. The codec circuit as claimed in claim 6, wherein the upper signal transmission cut-off frequency can be set by setting the setting filter coefficients of the programmable digital low-pass filter (29).

9. The codec circuit as claimed in one of the preceding claims 1 to 8, wherein a frequency response correction filter (10, 13) is also provided, in order to compensate for the ripple in the bandpass filter characteristic in the passband.

FIG 1

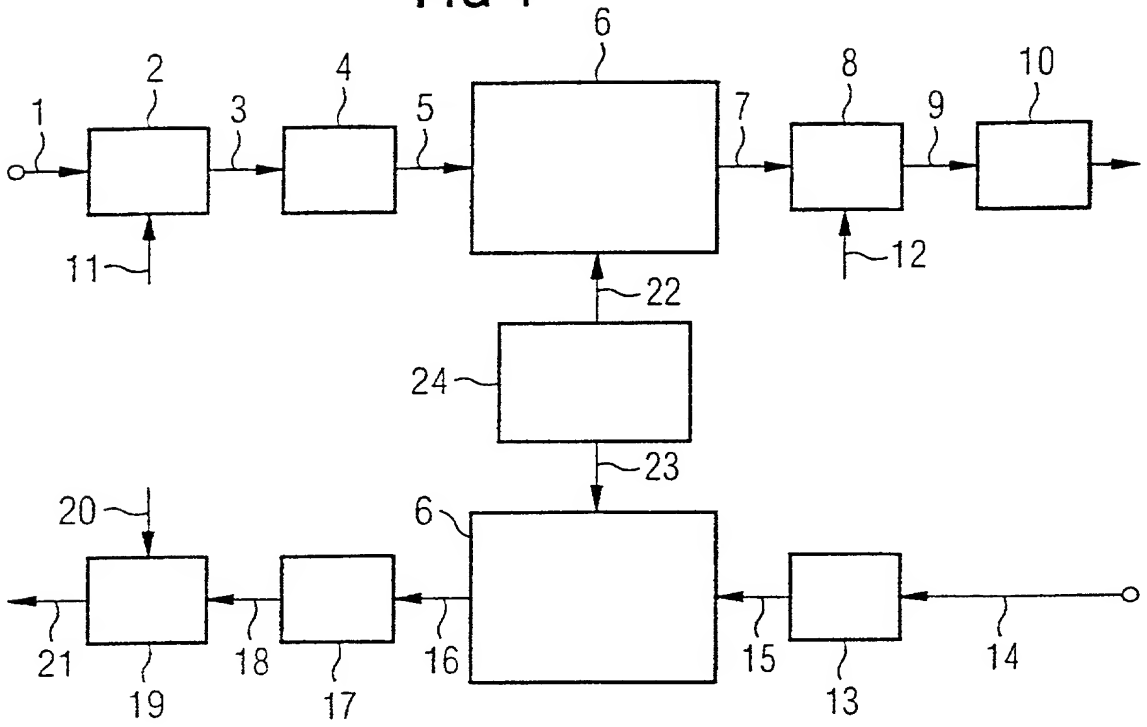

6
2
4
8
10
1
3
5
7
9
11
12
22
24
23
20
6
21
19
18
17
16
15
13
14

FIG 2

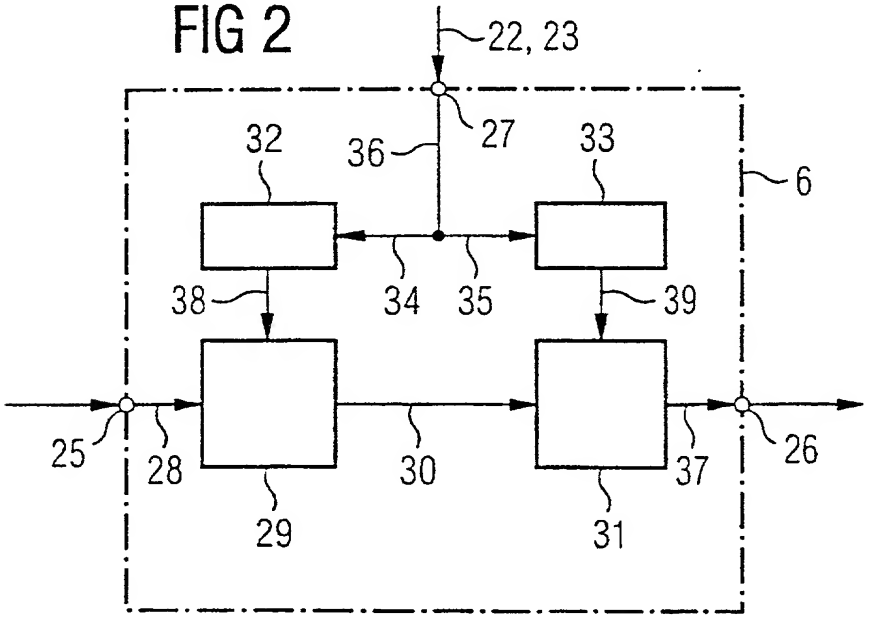
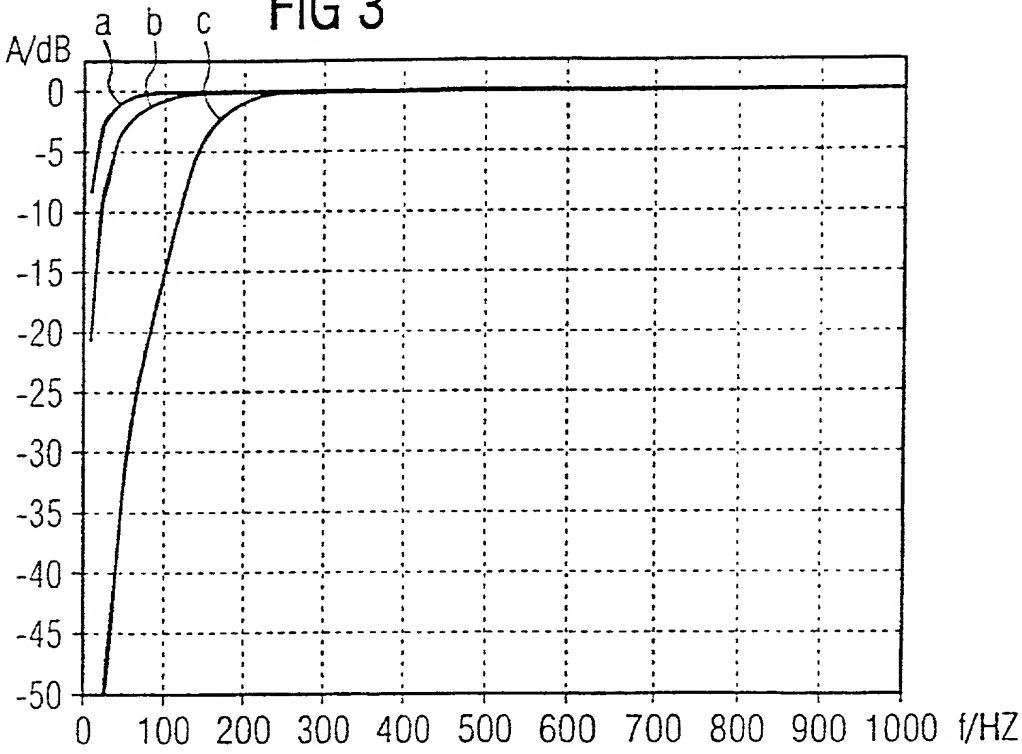

22, 23
27
32
36
33
6
38
34
35
39
25
28
30
37
26
29
31

FIG 3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b
c
A/dB
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-5
-10
-15
-20
-25
-30
-35
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-50
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300
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500
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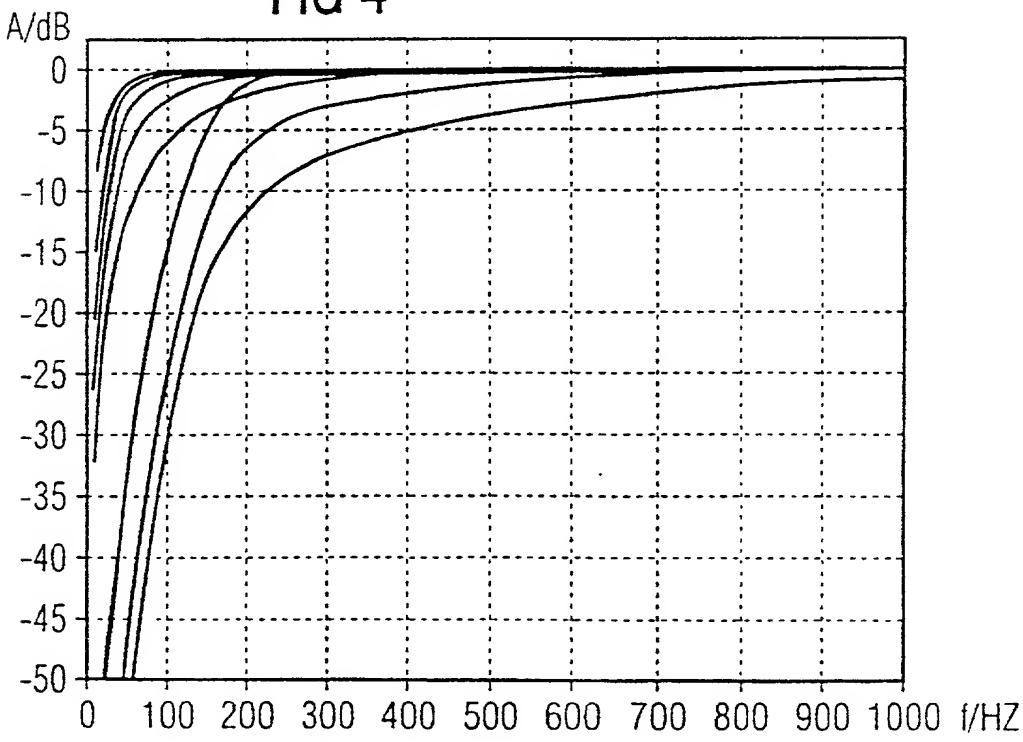
700
800
900
1000
f/HZ

FIG 4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-50
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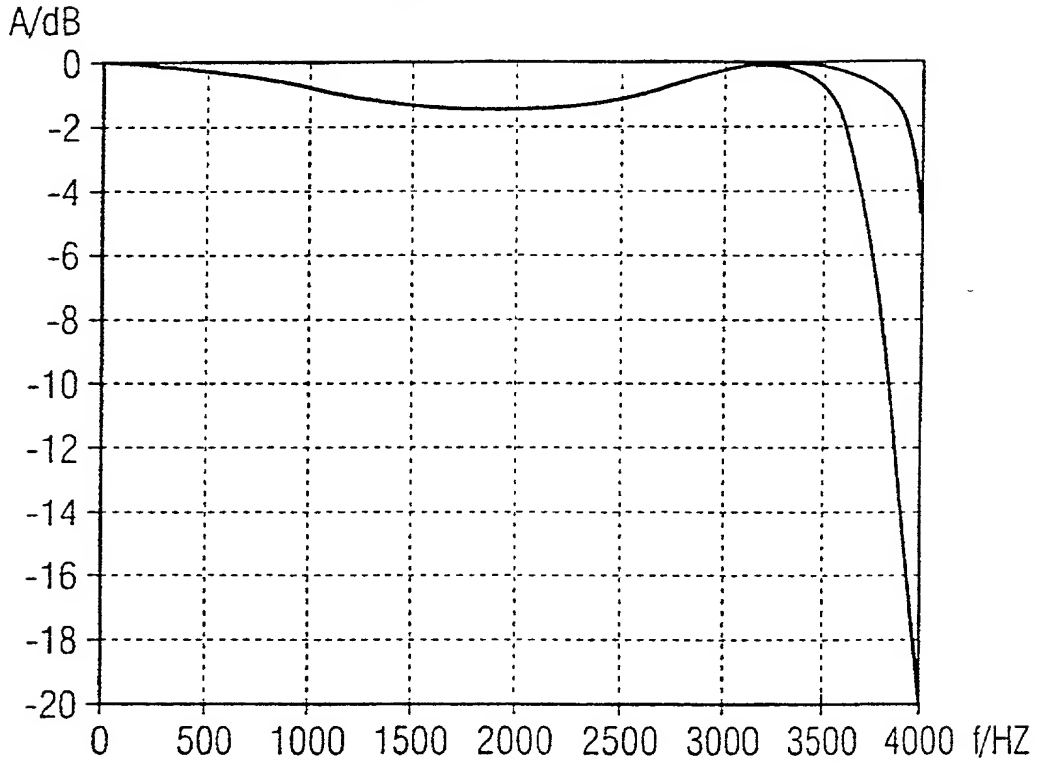
700
800
900
1000
f/HZ

FIG 5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-8
-10
-12
-14
-16
-18
-20
0
500
1000
1500
2000
2500
3000
3500
4000
f/HZ

S 1619

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	1406/34
First Named Inventor	KOGLER, Manfred
COMPLETE IF KNOWN	
Application Number	10/018,976
Filing Date	December 18, 2001
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CODEC CIRCUIT HAVING A PROGRAMMABLE DIGITAL BANDPASS FILTER

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 12/18/2001 as United States Application Number or PCT International Application Number 10/018,976 and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
199 29 169.1	Germany	06/25/1999	☐	☐	☒
PCT/DE00/02065	WIPO	06/26/2000	☐	☐	☒
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

Please type a plus sign (+) inside this box → [+]

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DECLARATION — Utility or Design Patent Application

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR : [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]): Manfred | Family Name or Surname: Kogler

Inventor's Signature: Manfred Kogler | Date

Residence: City ~~Villach~~ Klagenfurt | State | Country AT | Citizenship AT

Mailing Address: Annabichlerstr. 21

Mailing Address

City ~~Villach~~ Klagenfurt | State | ZIP A-9020 ~~A-9500~~ | Country Austria

NAME OF SECOND INVENTOR: [ ] A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) | Family Name or Surname

Inventor's Signature | Date

Residence: City | State | Country | Citizenship

Mailing Address

Mailing Address

City | State | ZIP | Country

[ ] Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.